

An Initial Look at DoD's Activities Toward Climate Change Resiliency

An Annotated Bibliography

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Preface

The global effects of climate change could have widespread effects and thus pose concerns for all governments and their agencies. The United States and the Department of Defense (DoD) are no exceptions, and the latter has been taking steps to assess potential effects and consider possible responses. Many elements of the Department have taken steps to begin dealing with the implications of climate change and have published reports, directives and other documents to guide department actions. This working paper pulls together those documents that could be identified through a search of public databases. This draft working paper should interest policy makers and managers in the Department of Defense interested in background material on how the Department is approaching climate change resiliency and adaptation.

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Abstract

This Working Paper presents a draft annotated bibliography of select government reports issued within the last five years on how DoD is planning and preparing for the effects of a changing climate.

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Abbreviations

AFCEC	Air Force Civil Engineer Center
AFSOC	Air Force Special Operations Command
AMC	Army Materiel Command
AOR	Area of responsibility
ASA (ALT)	Assistant Secretary of the Army (Acquisition, Logistics, Technology)
ASB	Army Science Board
CEQ	Council on Environmental Quality
CNO	Chief of Naval Operations
CRS	Congressional Research Service
DHS	Department of Homeland Security
DoD	Department of Defense
DoDD	Department of Defense Directive
DoI	Department of the Interior
DoS	Department of State
DoT	Department of Transportation
EO	Executive order
EOP	Executive Office of the President
ERDC/CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
FEMA	Federal Emergency Management Agency
FORSCOM	Forces Command
GAO	Government Accountability Office
GCC	Geographic Combatant Commands
GHG	Green-house gasses
HA/DR	Humanitarian aid/disaster relief
HADA	Headquarters, Department of the Army
ICEMAP	Installation Complex Encroachment Management Action Plans

INRMP	Integrated Natural Resource Management Plans
IPCC	Intergovernmental Panel on Climate Change
NGB	National Guard Bureau
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NORAD/ USNORTHCOM	North American Aerospace Defense Command/U.S. Northern Command
OCAR	Office of the Chief Army Reserve
OHDACA	Overseas Humanitarian Disaster and Civic Aid appropriation
OSTP	Office of Science and Technology Policy
POM	Program Objective Memorandum
RDT&E	Research, Development, Test & Evaluation
S&T	Science and Technology
SAR	Search and rescue
SERDP	Strategic Environmental Research and Development Program
SESC	Senior Energy and Sustainability Council
SOF	Special Operations Forces
SSC	Senior Sustainability Council
SSPP	Strategic Sustainability Performance Plan
TCP	Theater Campaign Plan
T&ES	Threatened and endangered species
TFCC	Task Force Climate Change
TRADOC	Training and Doctrine Command
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USAFRICOM	U.S. Africa Command
USAID	U.S. Agency for International Development
USCG	U.S. Coast Guard
USCENTCOM	U.S. Central Command
USEUCOM	U.S. European Command

USSOCOM	U.S. Special Operations Command
USPACOM	U.S. Pacific Command
USSOUTHCOM	U.S. Southern Command
VTOL	Vertical take-off and landing

Literature on the Defense Department's Climate Change Activities

This preliminary literature survey, limited to publically available government documents, presents an initial overview of what the Department is doing to respond to likely climate change effects. We focused on what the Department is doing, thus further limiting our survey to studies that looked at climate change scenarios and on how these may affect various Defense Department activities.

The consensus in the literature surveyed is that climate change poses risk to the Department of Defense's readiness, operations, and strategies. Therefore all DoD activities—strategic and theater-level engagements; operations, logistical demands; personnel training requirements and conditions; and investments in infrastructure, weapon systems, and equipment—will need to respond, or adapt, to these effects if strategic objectives, mission capability, and readiness are to be maintained.

Many White House and departmental reports and studies have identified and assessed these high-level effects, and the Department has responded with strategy and policy statements, most recently in the *2014 Defense Quadrennial Review*, Defense Science Board study *Trends and Implications of Climate Change for National and International Security (2011)*, and the *DoD Climate Change Roadmap (2014)*. Additionally, the Department issued a comprehensive directive, *DoDD 4715.21 Climate Change Adaptation and Resilience (2016)*, which outlines the responsibilities of the major organizations within the Department for managing climate change risks. In addition, most services have created task forces and developed their own roadmaps to identify policy, guidance, and information necessary to manage these risks. The Navy's roadmap is structured particularly well and includes an implementation plan that identifies actionable items, responsibilities, and time frames (an example is presented later in this report).

Yet much work remains to adapt to and mitigate both short- and long-term effects of climate change on the Department's operations and functions. Implementing DoDD 4715.21, other Departmental guidance (for example, installation master planning or integrated natural resource management guidance) and any roadmaps will require leadership, resources, knowledge and information mechanisms to ensure these issues are incorporated into decision making to the degree practicable, and tracking progress (the Sustainability Reports will provide some top-level measures). One significant challenge will be to make the appropriate investments, given the competition for the Department's resources, knowledge gaps, risk uncertainties, and, in some cases, the long-lead times required for some responses.

Clearly, dealing with climate change fosters a demand for new information needs as well as research and organizational linkages for the collection of necessary information. Our impressions are that for the Department as a whole to continue to make progress toward sufficiently mitigating and adapting to climate change while effectively performing its missions it will need

to perform additional capability and vulnerability assessments that incorporate these potential effects, which in turn will require access to novel, actionable data in many technical and functional areas (operations, installations, weapon systems, equipment, cost/budget, and personnel). Thus, climate change will require the Department to coordinate with new and diverse partners and perhaps more closely with existing partners on data and information gathering, to assess, plan, and invest in both operational, support, and infrastructure activities to achieve national security objectives.

This process will require coordination both with internal and external entities, and the Department will need the requisite resources, capability to engage a broader community, and procedures or methods to validate, share, and disseminate new information. Moreover, procedures and practices need to be in place to make sure data is of high quality and applied consistently, allowing for regional and local circumstances. The Department will also likely have to work more closely with allies and partners to develop operational plans and training exercises when these effects alter current operations and supply activities or place new demands on them. Just as operational commands rely on allies and host countries for support, military installations rely on infrastructure outside the Department. Closer coordination and long-term planning with local communities that provide services such as water, roads, power, workforce, and housing to military installations will also help improve resiliency in the face of likely climate change effects. Many of the documents surveyed acknowledge these needs and the actions the Department is taking to address them.

Furthermore, for the Department to invest in the necessary plans and programs to mitigate or adapt to climate change, there must be suitable data and processes to make the “business case” for these actions and investments. Personnel must have an awareness and appropriate training to have the skills necessary to manage these risks. And finally, there needs to be a way to ensure the proper resources are applied to climate change adaptation and resiliency, that there is enduring, consistent leadership on the issue and accountability for pursuing objectives and attaining goals. As with other issues, it will be somewhat challenging to identify those resources supporting climate change adaptation and resiliency given that the processes and resources used to address these issues are integrated with standard DoD management systems (as they should be).

This Literature Survey

The following lists and briefly describes documents identified in this initial sampling of DoD activities related to climate change resiliency and adaptation.¹ As mentioned, documents surveyed came from the publically available literature on actions taken by the DoD within the last few years. Most of these are headquarters-level documents where climate change is a

¹ Searches for high level government documents specifically addressing climate change were performed using Google, DENIX, and DTIC search engines, and GAO, White House, SERDP, AFCEC, DoD, USACE, and CRS websites.

primary issue.² They are organized by document focus—strategy and policy, planning and guidance, directives and memorandum, research, analyses, and methods development, and audits—and occur roughly in reverse chronological order (sometimes companion documents were placed together and not in strict chronological order). Because DoDD 4715.21, “Climate Change Adaptation and Resilience,” January 14, 2016 provides a roadmap to the responsibilities and activities of the entire DoD, Appendix A arrays DoDD 4715.21 by organization and functional focus as a way of quickly seeing responsibilities for an area of interest.

Climate Change Strategy and Policy Documents

Executive Office of the President “National Security Strategy,” February 2015,
https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf

The White House identifies climate change as a top eight strategic risk to U.S. efforts, explicitly noting that climate change contributes to increased natural disasters, refugee overflows, and conflicts over food and water resources.

White House, “Findings from Select Federal Reports: The National Security Implications of a Changing Climate,” 2015,
https://www.whitehouse.gov/sites/default/files/docs/national_security_implications_of_changing_climate_final_051915_embargo.pdf

Drawing upon the Third National Climate Assessment, the White House’s 2015 National Security Strategy, and the DoD’s 2014 Quadrennial Defense Review, this document summarizes both the nature of threats posed by climate change and the ways that the federal government is responding to them. The document recommends strengthening coastal military installations that are vulnerable to flooding and preparing other critical infrastructures (e.g., energy transportation, transmission, and distribution) for climate changes; advancing U.S. security interests and ability to respond to climate changes in the Arctic region and internationally; preparing for effects on military readiness, operations, and weapons systems.

Department of Defense, “National Security Implications of Climate-Related Risks and a Changing Climate,” July, 2015 accessed at: <http://archive.defense.gov/pubs/150724-congressional-report-on-national-implications-of-climate-change.pdf?source=govdelivery>

This document responds to Senate Committee on Appropriations request for a report on the most serious and likely climate related security risks for each Combatant Command; ways to

² Because this is a preliminary review we did not sample reports that may be relevant to climate change mitigation and adaptation but have broader applicability (such as energy security, natural resource management, or building design criteria for example). Nor were we able to sample documents by individual installations and commands, although we tried to capture information on activities at this level where possible.

integrate risk mitigation in planning processes for humanitarian disaster relief, security cooperation, building partner capacity, and sharing best practices for mitigation of installation vulnerabilities; and information on the resources and associated timeline required for an effective response. The focus is mostly near-term (five year) response to climate change for Geographic Combatant Commands (GCC).

Climate change risks are incorporated into GCC's planning processes, resource requirements, and operational considerations.

- Planning processes include: theater campaign plans, operation plans, contingency plans, and theater security cooperation plans. AF 14th Weather Squadron provides data and decision aids. National Oceanic and Atmospheric Administration (NOAA) provides long-term projections, and weather forecasts.
- All GCC are working with partner nations in the areas of building infrastructure for disaster response; training in disaster response and management; and equipping so they can provide Non-governmental organization (NGOs) with emergency donations.
- Services have been directed to perform a global screening level assessment of installations' vulnerabilities to climate changes and these assessments will be used to determine adaptation strategies.

Resources for Combatant Commands to assess and respond to climate change are generally included within existing mission funding procedures as driven by Theater Campaign Plans (TCPs). Resources for resiliency are incorporated into risk management processes. Training may require additional resources for accessing and understanding climate and weather data. In addition, the need for additional coordination with partner nation organizations, particularly in the areas of Humanitarian aid/disaster relief (HA/DR), Search and rescue (SAR), and environmental and natural resource management, may also add to personnel responsibilities (and cost). Humanitarian assistance and disaster relief, funded in the Overseas Humanitarian Disaster and Civic Aid appropriation (OHDACA), will incur additional costs (for airlift, water supply, engineering equipment for debris removal, medical care, communications, electricity repair, SAR, and port and traffic control). Resources required for the Arctic region will likely have longer and more costly acquisition and supply chain requirements.

Overall the combatant commands treat climate change effects as additional stressors within their TCP and intend to continue to monitor, assess, and integrate these risks into overall management processes. U.S. Africa Command (USAFRICOM) believes climate change effects will act as threat multipliers as well as increase the need for humanitarian assistance. Therefore, USAFRICOM incorporates these effects into its annual TCP reviews and plans to expand engagements with partner nations within its security cooperation programs and humanitarian aid/disaster relief (HA/DR) planning [aligning with U.S. Agency for International Development (USAID) as well]. U.S. Central Command (USCENTCOM) uses historic climatic conditions and indicators of water scarcity in its TCP, which also includes HA/DR and security cooperation programs. The Services are responsible for considering effects on installations in this area of responsibility (AOR). U.S. European Command (USEUCOM) focuses on increased commercial

activity and SAR demands in the Arctic, and utilizes information from the Arctic Security Forces Roundtable to inform its TCP as well as insights from the Arctic Zephyr SAR tabletop exercises to inform SAR planning in the region. North American Aerospace Defense Command/U.S. Northern Command (NORAD/USNORTHCOM) focuses on extreme weather events and changes in the Arctic region. Operational planning tools incorporate severe weather and catastrophic events. Extreme weather-driven scenarios are used in training events and exercises. SAR planning includes the Arctic Zephyr table top and cooperative SAR exercises with Canada. U.S. Pacific Command (USPACOM) is planning for the consequences of sea-level rise (in its response to natural disasters) and additional stress on natural resources (sustainable resource management to reduce conflict) in its concepts of operations for Defense Support to Civil Authorities for pandemics/infection disease and HA/DR demands [also done in coordination with Department of State (DoS), USAID, Department of Homeland Security (DHS), Department of the Interior (DoI), and NOAA]. USPACOM also collaboration with countries in theater security as well as logistics planning operations and activities to incorporate disaster and critical resource security needs. A display tool that incorporates geographic, population, climate, weather, historic disaster, resource scarcity and hazards data is under development. U.S. Southern Command (USSOUTHCOM) assists partner nations with HA/DR but has not specifically identified actions resulting from climate change potential. National Preparedness Baseline Assessments look out five years and identify potential gaps in country capabilities. These assessments performed at the sub-regional level may identify vulnerabilities related to climate change. A 2014 report looked at the environmental and energy challenges (including climate change) for military forces in the countries of Chile, Colombia, El Salvador, and Trinidad and Tobago.

Air Force Special Operations Command, “Strategic Assessment of the Future Operating Environment,” November 2015.

This document, based on national and DoD strategy assessments conducted by the U.S. Air Force (USAF) and U.S. Special Operations Command (USSOCOM), synthesizes the consensus future global and international relations trends most relevant to Air Force Special Operations Command (AFSOC) strategic planning and helping to prioritize limited resources towards the most critical future needs. Climate change effects on global conflicts and associated natural resource pressures/demands are identified as top future trends that will have implications for special operations forces (SOF) Airmen and the collective strategic environments that they operate within.

Department of Defense, “Quadrennial Defense Review,” 2014 accessed at:

http://www.defense.gov/Portals/1/features/defenseReviews/QDR/2014_Quadrennial_Defense_Review.pdf

The review notes that climate change may increase the frequency, scale, and complexity of future missions, including defense support to civil authorities, because of the destabilizing effects of sea level rise, extreme weather, and competition for scarce natural resources. With respect to U.S. installations, climate change may also degrade training capabilities as well as energy and water security (although it notes investments in energy and water security will help mitigate these effects). At this time the Department planned to perform an assessment of installation vulnerability to climate change effects.

“White House National Strategy for the Arctic Region,” May 2013,
https://www.whitehouse.gov/sites/default/files/docs/nat_arctic_strategy.pdf

Because of changing Arctic climate conditions, the White House’s National Strategy for the Arctic Region includes developing and maintaining the capacity of execute Federal responsibility in the U.S.’s Arctic waters, airspace, and coastal regions, enhancing US understanding of Arctic conditions and trends that may affect national security, and responsibly developing Arctic oil and gas resources for future energy security.

U.S. Coast Guard, “Arctic Strategy,” May 2013,
https://www.uscg.mil/seniorleadership/DOCS/CG_Arctic_Strategy.pdf

This document outlines three strategic objectives in the Arctic for the U.S. Coast Guard (USCG) over the next 10 years (~2013-2023). This strategy is guided by direction from the President of the United States, including the National Security Strategy, National Military and Maritime Strategies, National Strategy for the Arctic Region, Arctic Region Policy NSPD-66/HSPD-25, National Strategies for Homeland Security and Maritime Domain Awareness, National Ocean Policy, Executive Order 13580 Interagency Working Group on Coordination for Domestic Energy Development and Permitting in Alaska, as well as the Quadrennial Defense, Diplomatic, and Homeland Security reviews. This document lay out a theater strategy for the U.S. Coast Guard’s operations in the Arctic region. It is not an implementation plan. The Coast Guard meets Arctic mission responsibilities by making difficult trade-offs. Therefore, as human activity increases in the region, this strategy will guide prudent investments to support national objectives by leveraging the Coast Guard's unique capabilities, authorities, and partnerships.

The document identifies three strategic objectives in the Arctic for the USCG: (1) Improving awareness, which is currently restricted because of limited surveillance, monitoring, and information system capabilities. This objective will require close collaboration within DHS, as well as with the Departments of State, Defense, Interior, the National Science Foundation and other stakeholders; (2) Modernizing governance by fostering collective efforts (within the Coast Guard’s authorities), to improve Arctic governance, especially of maritime activity and natural resources in the region. The Coast Guard will review its own institutions and governance to prepare for future missions throughout the Arctic; and (3) Broadening partnerships with

governmental and private partners internationally, nationally, and locally to ensure close cooperation to support national interests. Given the interrelated Arctic issues and interests in the region partnerships are necessary to identify and implement strategies. For example, this will include working closely within other federal agencies such as DHS, as well as with the DoS, DoI and other federal partners because the United States chairs the Arctic Council in 2015-2017.

Army Environmental Policy Institute, “Army Water Security Strategy,” December 2011.

Accessed at: <http://www.aepi.army.mil/docs/whatsnew/ArmyWaterStrategy.pdf>

This strategy document defines Army water security, provides information on water security management in the Army, and identifies where the Army leadership can focus to ensure adequate supply in the foreseeable future. Four goals are identified: preserve sources and protect rights to these sources; conserve water; maintain infrastructure integrity and security; and increase self-sufficiency at contingency bases. The document discusses each goal and strategies for attaining that goal. For example preserving sources and protecting rights encourages installation personnel to consider such issues as long-term requirements, conditions outside the fence line, and emergency response to name a few. Conservation incorporates such strategies as reducing withdrawals and use, matching quality to use, and developing a culture of conservation. While maintaining infrastructure incorporates recapitalization, anticipated costs, and assessing infrastructure vulnerabilities to naturally occurring events. Contingency basing self-sufficiency involves conservation but also engaging and assisting partner nations. Climate change is one underlying factor that may influence how these strategies are employed.

Executive Orders

Executive Order 13653, “Preparing the United States for the Impacts of Climate Change,”

November 2015, <https://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change>

This order directs the DoD to help complete an inventory and assessment of proposed and completed changes to its land- and water-related policies, programs, and regulations necessary to make the nation's watersheds, natural resources, and ecosystems, and the communities and economies that depend on them more resilient in the face of a changing climate. DoD must also help develop and provide authoritative, easily accessible, usable, and timely data, information, and decision-support tools on climate preparedness and resilience. DoD shall develop or continue to develop, implement, and update comprehensive plans that integrate consideration of climate change into agency operations and overall mission objectives and submit those plans to Council on Environmental Quality (CEQ) and Office of Management and Budget (OMB) for review.

Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” October 2009, accessed at: <https://www.whitehouse.gov/the-press-office/president-obama-signs-executive-order-focused-federal-leadership-environmental-ener>

This order requires federal agencies to set a 2020 greenhouse gas emissions reduction target, to increase energy efficiency, reduce fossil fuel consumption, conserve water, reduce waste, support sustainable communities, and leverage federal purchasing power to promote environmentally responsible products and technologies. DoE, in coordination with DoD and other agencies, must provide recommendations on greenhouse gas accounting and reporting to carry out agency obligations within this order. Department of Transportation (DoT), in coordination with DoD and other agencies, must submit recommendations for sustainable locations of federal facilities as part of agency sustainability plans stemming from this order.

Executive Order 13547, “Stewardship of the Ocean, Our Coasts, and the Great Lakes (National Ocean Policy),” July 2010 accessed at: <https://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes>

This order directs executive agencies to implement Interagency Ocean Policy Task Force recommendations under the guidance of a National Ocean Council for establishing a national policy to ensure the protection, maintenance, and restoration of ocean, coastal, and Great Lakes ecosystems and resources. The Secretary of Defense, among others, shall be part of the established National Ocean Council.

Executive Order 13690, “Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input ,” January 2015, accessed at: <https://www.whitehouse.gov/the-press-office/2015/01/30/executive-order-establishing-federal-flood-risk-management-standard-and->

This order seeks to improve the Nation’s resilience to current and future flood risks. Consistent with the President’s Climate Action Plan and through the leadership of the National Security Council, the Federal Flood Risk Management Standard was developed to provide a flexible framework to increase flooding resilience.

Executive Order 12881 “Establishment of the National Science and Technology Council” (November 1993), accessed at: <https://www.archives.gov/federal-register/executive-orders/pdf/12881.pdf>

This order establishes the National Science and Technology Council, whose membership includes the Secretary of Defense. The primary functions of the Council are to coordinate the science and technology policy-making process, ensure its consistency with the President’s stated

goals, integrate its agenda across the federal government, and further international cooperation in science and technology.

Climate Change Adaptation Planning and Reporting

Executive Office of the President, “Climate Action Plan.” June 2013,

<https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>

The White House recommends investing in more usage of renewable energy resources for the military, noting that the Navy is currently helping to develop cost-competitive advanced biofuels for military use and that the DoD (the single largest consumer of energy in the United States) is committed to deploying three gigawatts of renewable energy on military installations by 2025. The document also recommends boosting resilience of defense infrastructure, noting the DoD is assessing the relative vulnerability of its coastal facilities to climate change. And finally, an emphasis of the plan is to promote resilience by protecting biodiversity and conserving natural resources on federal lands.

OSD AT&L, “Department of Defense Strategic Sustainability Performance Plan FY 2015,” accessed at: <http://www.denix.osd.mil/sustainability/upload/DoD-SSPP-FY15-Final.pdf>

The DoD Strategic Sustainability Performance Plan (SSPP), required by Executive Order (EO) 1351, summarizes the Department’s approach to sustainability and provides a coherent approach for complying with multiple federal requirements for sustainability. Updated annually the first plan was developed in 2010. The Department must develop, implement and annually update a plan that prioritizes actions based on a positive return on investment to meet greenhouse gas (GHG) emissions, energy, water, waste reduction targets, and now climate change resiliency and vulnerability assessment goals through FY 2020. As of the FY 2015 report, the Department had not yet established sub-goals for climate change resiliency and vulnerability assessments.

However, the plan summarizes what DoD is doing to prepare for climate change. The Department reviewed 59 of its directives, instructions, and manuals and found 29 needed updating to incorporate climate change considerations, (updates are expected to be ongoing to 2018). The Department also issued new policy guidance to cope with consequences of climate change in a Floodplain Management policy memorandum (February 2014); and a policy memorandum on water rights and water resources management on US-based installations and ranges (May 2014). Additionally, the Department continued assessments of installations’ vulnerability from severe weather and projected changes in climate beginning with coastal areas, and extending to the remaining installations worldwide (completed in FY15). The Department also piloted a tool to assess installation water needs and initiated a pilot on Regional Climate Change Adaptation Planning (to be completed in FY16) in three areas: Hampton Roads, VA

(Navy), Michigan (Army National Guard)³, and Mountain Home, ID (Air Force). And finally, a Geographic Combatant Commanders Climate Change Information Exchange was convened and members participated in a workshop led by the Federal Emergency Management Agency (FEMA).

“Johnson, Wanda and Lorri Schwartz, “Spotlight: Planning for Climate Change,” in *Natural Selections*, DoD Natural Resources Program, Fall 2015 accessed at:
https://www.dodlegacy.org/Legacy/Documents/635882772545607001NaturalSelections_Fall2015_final_hr.pdf

The Army has incorporated climate change considerations into existing planning processes such as the Integrated Natural Resource Management Plans, real property management plans, and range complex master plans at several installations and is using these plans to develop guidance for all Army installations. This guidance states what types of information and projections are appropriate, where to find these data, and agency planning partners that could provide expertise and regional data. The mapping of climate-related factors into emergency response plans, range complex master plans, and guidance for potable water system planning is also underway. The Army is also looking into identifying data that can be collected consistently enterprise-wide to enable planning and execution of climate-related projects, equipment purchases, and infrastructure design.

“Kowalczyk, Daniel and Michelle Brown, “Air Force Planning for Climate Change,” in *Natural Selections*, DoD Natural Resources Program, Fall 2015 accessed at:
https://www.dodlegacy.org/Legacy/Documents/635882772545607001NaturalSelections_Fall2015_final_hr.pdf

This article discusses what the Air Force is doing to incorporate climate change into planning processes. For one, the Air Force Civil Engineer Center (AFCEC) is conducting a coastal erosion study of three early warning locations in the Arctic to assess the vulnerabilities and risks to airfields, radomes, and other infrastructure critical to the long range radar mission, as well as to other environmentally sensitive areas [landfills, threatened and endangered species (T&ES) habitats, regulated sites, cultural resources]. Information from this study will be used to update the land use management plans and support vulnerability assessments for additional installations with early warning assets. Installation Development Plans are part of the installation planning process. Sustainability Development Indicators are used to incorporate sustainability concepts within these Installation Development Plans. The Air Force has added a climate change

³The focus is on training lands at Camp Grayling and Fort Custer in partnership with the Michigan Departments of Natural Resources, Environmental Quality, and Transportation; the State Police; Michigan State University; and surrounding communities.

vulnerability category with metrics to account for climate-effects such as flooding, temperature rise, changing precipitation patterns, water supply stress, and droughts that may affect the resiliency of installation development. And Cape Canaveral Air Force Station, in collaboration with the National Aeronautics and Space Administration (NASA), is developing an adaptation strategy for vulnerabilities identified using historical and climate information, and is modifying its installation development plan (IDP) to move new development of launch pads and support facilities further away from the shoreline. Eglin AFB has a comprehensive database of historic changes in the coast [funded by Strategic Environmental Research and Development Program (SERDP)] that was used to develop a predictive model of large storm effects. This model can be used with sea level rise scenarios to characterize storm effects on natural and built infrastructure in the coastal zone, as well as saltwater migration into freshwater aquifers. Another planning tool used by installations is the Installation Complex Encroachment Management Action Plans (ICEMAPs), which have a climate effects category that includes severe weather, natural disasters, and coastal erosion.

Chiu, Dr. Daniel Y., Deputy Assistant Secretary of Defense for Strategy and Force Development, “The National Security Implications of Climate Change,” Submitted to the Senate Committee on Foreign Relations, Subcommittee on International Development and Foreign Assistance, Economic Affairs, International Environmental Protection, and Peace, July 22, 2014.

Dr. Chiu testified that in the near term the effects of climate change, as indicated in the National Climate Assessment (2014), will have serious implications for the Department’s infrastructure and the surrounding natural landscape. Dr. Chiu’s testimony identifies the specific ways in which sea-level rise, storms, and higher temperatures will affect military installations and personnel health and safety; and he outlines actions being taken to address some of these effects. For example, the Department had screened 58 existing directives, policies, manuals, and associated guidance documents and criteria to identify which ones should incorporate considerations of a changing climate and found 28 policies, programs and procedures needed updates (five of these, dealing with installations, had been updated by the time of his testimony). In addition, several installation infrastructure managers upgraded to more wind-resistant structures, buried utility lines, protected water supply wells, and removed vulnerable trees after experiencing extreme storm events. Other installations prepared better firebreaks in anticipation of more wildfires. Master planning criteria and building design requirements (including potential increased heating or cooling requirements) also require the consideration of climatic conditions. A Floodplain Management Policy (February 2014) establishes requirements to minimize risks when military assets must be located within flood plains. The Department is also exploring expanding risk management schemes used for locating infrastructure within the Defense Critical Infrastructure Program to other infrastructure decisions and has piloted a screening level assessment tool of installations. It is pursuing a “phased installation-level vulnerability

assessment approach to: develop methodologies for conducting consistent screening-level vulnerability assessments of military installations world-wide (starting with coastal and tidal installations); leverage recent scientific advancements regarding coastal assessment; and provide a platform to build upon prior to conducting more comprehensive and detailed assessments, whether coastal installations or otherwise.” And finally, departmental research programs such as the SERDP are focusing on characterizing climate change impacts in specific regions of the world, beginning with coastal regions, and developing methodologies for vulnerability assessments and adaptation strategies. Other areas being studied are the interior of Alaska (training lands and infrastructure), the Pacific Islands (water supplies), and the response of sensitive species and ecosystems.

In terms of the longer-term Dr. Chui notes that climate change may alter or constrain military operating environments in the future, and that it can be a threat multiplier. The Department released a DoD Arctic Strategy that acknowledges the need for both interagency and international cooperation through many councils, cooperative exercises, and other engagements in this region. In order for the Department to better understand how these changes will affect operations it is identifying early warning indicators for those areas critical to its missions, conducting regional and localized assessments, and is monitoring developments through security cooperation or capacity building. The department’s leadership is also incorporating climate change into planning scenarios that inform strategy and planning, programming, budgeting, and execution. Combatant commands are looking into ways of using non-combat support to address climate change-related U.S. national security vulnerabilities and to include climate considerations in theater campaign plans as well as into humanitarian assistance and disaster relief and other exercises. Planning activities also look to enhance the capacity of partner militaries and civil response readiness groups as well as to more systematically utilize the National Guard, U.S. Army Corps of Engineers, Naval Facilities Command, and other non-combatant organizations. Finally, the Department participates in many collaborative and cooperative interagency working groups and councils.

OASD (Energy, Installations & Environment) “Climate Change Adaptation Roadmap (CCAR),” October 2014.

As required by EO 13653, the DoD completed a review of the 2012 DoD Climate Change Adaptation Roadmap and revamped the roadmap in 2014.

The 2014 roadmap identifies three comprehensive goals: 1) to identify and assess the effects of a changing climate on the Department’s infrastructure, mission, and activities; 2) to identify, manage, and integrate climate change considerations across all Department missions and activities; and 3) to collaborate with internal and external entities on understanding, assessing, and developing responses to the challenges posed by climate change. These goals are discussed

within four focus areas: plans and operations, training and testing, built and natural infrastructure, and acquisition and supply chain.

As of October 2014 the Department had nearly completed an initial assessment of installation vulnerabilities for over 7,000 installations.

White House, “Implementation Plan for the National Strategy for the Arctic Region,” November 2014 accessed at:

https://www.whitehouse.gov/sites/default/files/docs/implementation_plan_for_the_national_strategy_for_the_arctic_region_-_fi....pdf and “National Strategy for the Arctic Region Implementation Report,” January 2015 accessed at:
https://www.whitehouse.gov/sites/default/files/docs/report_on_implementation_of_the_national_strategy_for_the_arctic_region_....pdf

This Implementation Plan details objectives and agency responsibilities following the President’s National Strategy for the Arctic Region. The DoD is tasked as a lead agency for the objective to increase understanding of the Arctic through scientific research and traditional knowledge. The DoD is tasked as a supporting agency for the following objectives: sustain and support evolving aviation requirements; develop communication infrastructure in the Arctic; enhance Arctic domain awareness; preserve Arctic region freedom of the seas; promote international law and freedom of the seas; protect Arctic environment and conserve Arctic natural resources, use integrated Arctic management to balance economic development; environmental protection, and cultural values; improve understanding of glacial dynamics; understand atmospheric processes to improve climate predictions; support a circumpolar Arctic observing system; integrate Arctic regional models; enhance Arctic SAR; delineate the outer limit of the US extended continental shelf; and promote Arctic waterways management.

U.S. Navy Climate Change Task Force, “US Navy Arctic Roadmap 2014-2030,” February 2014, <http://greenfleet.dodlive.mil/files/2014/02/USN-Arctic-Roadmap-2014.pdf>

Prepared for the Department of the Navy, Chief Naval Operations, this roadmap updates the Navy’s Task Force Climate Change 2009 Arctic Roadmap. It focuses on near-term (through 2020) and mid-term (2020-2030) tasks in the Arctic Ocean, in response to rapidly changing climate conditions in that region. It is derived from the *National Strategy for the Arctic Region* (May 2013) and its Implementation Plan (January 2014), the *Department of Defense Arctic Strategy* (November 2013) as well as *Defense Strategic Guidance: Sustaining the U.S. Global Leadership: Priorities for 21st Century Defense* (January 2012); Executive Order 13547: *Stewardship of the Ocean, Our Coasts, and the Great Lakes (National Ocean Policy)* (July 2010); the *National Security Strategy* (May 2010); the *Quadrennial Defense Review* (February 2010); National Security Presidential Directive – 66/Homeland Security Presidential Directive –

25: Arctic Region Policy (January 2009); the *Cooperative Strategy for 21st Century Seapower 2007* (October 2007); and other applicable directives and policies.

This roadmap provides guidance necessary to prepare the Navy to respond to future Arctic Region contingencies, delineates the Navy's leadership role, and articulates the Navy's support to achieve national priorities in the Region. Three primary strategic drivers will determine the extent and timing of potential maritime and naval activity in the Arctic region: (1) Environmental Conditions, (2) Economic Interests and Strategic Resources, (3) Geopolitical Dynamics. In the near-term (present-2020): The Navy will continue to provide capability and presence primarily through undersea and air assets. By 2020, the Navy will increase the number of personnel trained in Arctic operations. In the mid-term (2020-2030), the Navy will have the necessary training and personnel to respond to contingencies and emergencies affecting national security. As the Arctic Ocean becomes increasingly ice-free, surface vessels will operate in the expanding open water areas. In the far-term (beyond 2030), Navy will be capable of supporting sustained operations in the Arctic Region as needed to meet national policy guidance. The Navy will provide trained and equipped personnel, along with surface, subsurface, and air capabilities, to achieve Combatant Commanders' objectives.

The roadmap contains an implementation plan for four main objectives and their associated tasks:

1. Strategy, Policy, Missions and Plans (shown in Fig. 1);
2. Operations and Training – science and technology; environmental observations and predictions; safe navigation; command, control, communications, computers, intelligence, surveillance, and reconnaissance; installations and facilities; platforms, weapons, support equipment, and sensors, and maritime domain awareness;
3. Build Trust and Confidence with Partners; and
4. Execution.

Figure 1 shows an example of the Navy's implementation plan for the "Strategy, Policy, Missions, and Plans" objective, highlighting the organizational responsibilities and implementation time frames for each action under the objective.

Figure 1. Example task and organizational structure from the Navy Arctic Roadmap Implementation Plan.

Arctic Roadmap Implementation Plan				
1.1 Strategy, Policy, Missions and Plans				
Actions	Lead	Support	DOTMLPF	Suspense
1.1.1: Establish a working group to codify near-term and potential mid-term requirements to inform POM-16 guidance and annually thereafter.	OPNAV N9	OPNAV N1 OPNAV N2/N6 OPNAV N3/N5 OPNAV N4 OPNAV N9 EUCOM NORTHCOM USFFC/CPF	D	Q1, FY14
1.1.2: Identify metrics suitable for CNO progress reports on Section 1.1 (Strategy, Policy, Missions, and Plans) of Arctic Roadmap.	OPNAV N3/N5	Director TFCC TFCC	D	Q3, FY14
1.1.3: Advocate that OSD designate SECNAV as the Department of Defense (DOD) Executive Agent for the Arctic.	OPNAV N3/N5		D	Q3, FY14
1.1.4: Reflect the Arctic objectives in Guidance for Employment of the Force (GEF).	OPNAV N3/N5	OPNAV N2/N6 OPNAV N4 OPNAV N8 OPNAV N9 USFFC/CPF ONR	D	Q3, FY14

U.S. Navy “Climate Change Roadmap,” May 2010,

<http://greenfleet.dodlive.mil/files/2010/08/US-Navy-Climate-Change-Roadmap-21-05-10.pdf>

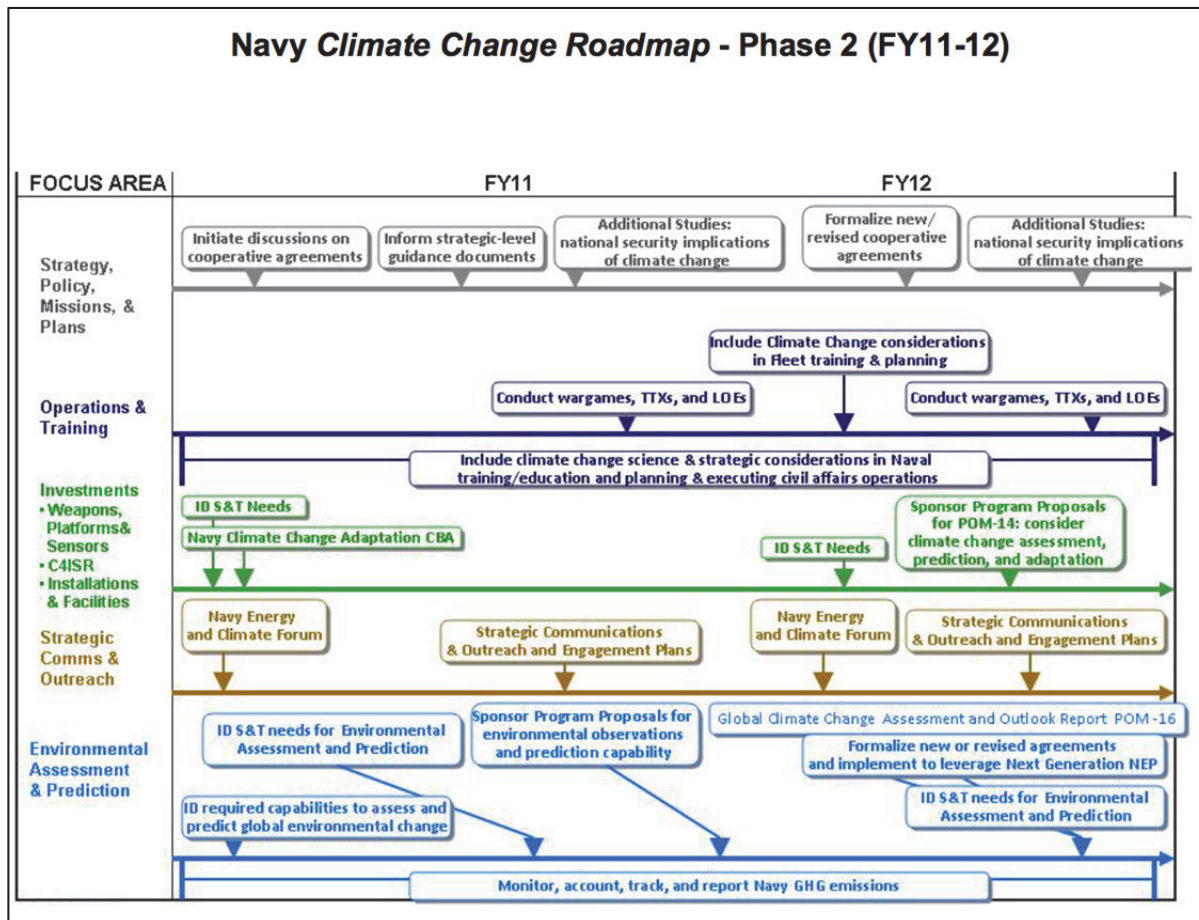
The roadmap presents the Navy’s approach to observing, predicting, and adapting to climate change by providing a chronological list of Navy associated action items, objectives, and desired effects for FY10-14. This document is a companion paper to the Navy’s *Energy Strategy*, and describes the Navy’s climate change mitigation efforts within five focus areas: (1) strategy, policy, and plans; (2) operations and training; (3) investments in capability and infrastructure; (4) strategic communications and outreach; and (5) environmental assessment and prediction. The intent of the roadmap is to address the Navy’s climate change concerns in the near-term (FY10-11) and the mid-term (FY12-14). An example of activities proposed within each focus area for FY11-12 is show in Figure 2.

In the near-term, the Navy plans to develop partnerships to respond to climate change, assess effects of climate change, and monitor the Navy’s carbon footprint reduction achieved through Task Force Energy’s energy security initiatives. In the mid-term, the Navy plans to address sea level rise effects on infrastructure and real estate through strategic investments, develop and implement installation adaptation strategies to deal with water resource challenges, and consider impact of climate change on future missions and force structure.

Action items during FY10 include the incorporation of climate change effects on national security in Naval War College coursework and to define requirements of a next generation

operational and climatic environmental prediction capability. Action items during FY11-12 (shown in Fig. 2) include: the incorporation of climate change considerations in strategic guidance documents; the development of recommendations to deal with climate change requirements in Sponsor Program Proposals for the Navy's Program Objective Memorandum for FY14 [Program Objective Memorandum (POM-14)]; the formalization of new cooperative relationships that increase the Navy's capability to assess, predict, and adapt to climate change; and the inclusion of climate change considerations in fleet training and planning. Action items for FY13-14 include: execution of the Navy POM-14 budget initiatives that address climate change and the initiation of intergovernmental, multilateral, and bilateral activities which increase the Navy's ability to assess, predict, and adapt to climate change.

Figure 2. Sample Action Items from the Navy Climate Change Roadmap



Army Science Board, “Planning for Climate Change: Actions for the Army to Better Adapt to the Effects of Climate Change in 2030,” November 2013 accessed at:
<http://www.dtic.mil/dtic/tr/fulltext/u2/a598412.pdf>

The Secretary of the Army requested the Army Science Board Study (ASB), which considers the Army response to climate change effects that will likely occur by 2030 and the practices that need to be put in place to adapt for effects occurring after 2030.

The ASB recommendations are for various organizations within the Army such as Training and Doctrine Command (TRADOC), to codify climate change effects within doctrine and capability based assessments and develop special units to enhance HA capability; Assistant Secretary of the Army (Acquisition, Logistics, Technology) [ASA (AL&T)], Headquarters, Department of the Army (HQDA) G3/G4, TRADOC, and Army Materiel Command (AMC) to review R&D and acquisition portfolios to ensure that mitigation opportunities are identified and capabilities are sufficient (including unmanned Vertical take-off and landing (VTOL); TRADOC, G3, Forces Command (FORSCOM), in conjunction with the National Guard Bureau (NGB) and the Office of the Chief of Army Reserve (OCAR) to review training practices to ensure they include the skills necessary and additional joint exercises for closer coordination with partners and NGOs; and for G3 to ensure that adaption is appropriate for long-term effects and that policy is incorporated into planning and progress is monitored; and for the science and technology(S&T) to invest in specified S&T needs.

Defense Science Board, “Trends and Implications of Climate Change on National and International Security,” November 2011 accessed at:
<http://www.acq.osd.mil/dsb/reports/ADA552760.pdf>

The report reviews the roles of the defense community and combatant commands and makes recommendations for furthering the department’s response to climate change. Information system needs are also presented.

U.S. Army Corps of Engineers, “Climate Change Adaptation Plan” June 2014, accessed at:
http://corpsclimate.us/docs/USACE_Adaptation_Plan_v50_2014_June_highres.pdf

Updated annually the U.S. Army Corps of Engineers (USACE) Adaptation Plan describes activities the agency is doing to evaluate and manage the most significant climate change related risks and vulnerabilities to infrastructure, operations and missions, in both the short and long term. It notes that USACE is continuing to develop, implement, and update comprehensive plans, policy, and guidance that incorporates climate change considerations into agency operations. The agency also collaborates extensively with external organizations to assist them with their climate change planning. For example, the agency is developing tools for vulnerability assessments, and piloting these assessments for its own use as well as for others. It is also piloting assessments and approaches for infrastructure resiliency, as well as offering training and

research on infrastructure resiliency. Other priorities identified in the plan is to improve the scientific knowledge of water resource management, manage lands and water for climate resiliency, and to provide information, data, and tools for climate change preparedness and planning.

The Army is one organization within the DoD that USACE is assisting. The USACE is helping the Army to update five major installation planning processes -- Installation Strategic Planning, Master Planning, Range Complex Master Planning, Integrated Natural Resource Management Planning, and Critical Infrastructure Risk Management -- to include climate change considerations. Plans are to extend the effort to emergency response plans and potable water master plans. In addition, the USACE is offering technical services (data sources, decision support, and analytical tools) to Army installation adaptation planning. It is also assisting the Combatant Commands engagements with host countries to develop engineering tools to perform vulnerability analyses (for example with USEUCOM, USAFRICACOM, and USPACOM).

The agency has also established climate change goals as presented in the USACE “2014 Strategic Sustainability Performance Plan” (June 2014).

Naval Studies Board and National Research Council, “National Security Implications of Climate Change for U.S. Naval Forces,” 2011 accessed at:

<http://www.nap.edu/catalog/12914/national-security-implications-of-climate-change-for-us-naval-forces>

The Chief of Naval Operations (CNO) established the Navy Task Force Climate Change (TFCC), which was directed to address long-term Navy policy, strategy, and plans as a result of climate change. This report speaks to both the near- and long-term implications for U.S. naval forces in four areas: operations, infrastructure, allied forces operations and capabilities, and anti-submarine warfare (the basis for U.S. warfighting advantage in the oceans). Findings and recommendations focus on six categories where there will be consequences: disputes over boundaries and economic zones resulting from new shipping areas and natural resource accessibility; additional demands on search and rescue activities because of expanded access to these areas; coastal installations’ vulnerabilities to sea-level rise and storm surge; increased demand for international maritime partnerships with allies and others; insufficient capabilities because of technical limits; and gaps in research, development, test and evaluation (RDT&E) investments required for future naval operations.

Departmental Directives and Guidance on Climate Change

DoDD 4715.21, “Climate Change Adaptation and Resilience,” January 14, 2016 accessed at:

<http://www.dtic.mil/whs/directives/corres/pdf/471521p.pdf>

In accordance with Executive Order 13653, this directive establishes policy and assigns responsibilities to assess and manage risks associated with the effects of climate change while

ensuring continuity of DoD operations. To assess and manage these risks properly and implement the 2014 DoD Climate Change Adaptation Roadmap, the Department will need to engage in cooperative efforts with other federal, state, local, tribal, private sector, and nonprofit sector. These policies and responsibilities will enable the DoD to identify the resources required to adapt to climate change effects while ensuring DoD operations and mission effectiveness and safeguarding infrastructure, environment and natural resources. (See our matrix of organizational responsibilities by function in Appendix A.)

DoDI 4715.03, “Natural Resources Conservation Program,” November 25, 2013 accessed at: <http://www.dtic.mil/whs/directives/corres/pdf/471503m.pdf>

This instruction implements policy and assigns responsibilities for compliance with applicable Federal statutory and regulatory requirements, executive orders (E.O.), and Presidential Memorandums for the integrated management of natural resources controlled by the Department of Defense. The instruction contains natural resources conservation metrics and procedures for the DoD Conservation Committee. Enclosure 8 to the document covers how to incorporate climate change into Integrated Natural Resource Management Plans (INRMPs).

Departmental Task Forces and Working Groups on Climate Change

Table 1 lists the climate change task forces currently operating in within DoD and the services. Note, the OSD and the services are collaborating with many other federal agencies and international partners, and Table 1 only presents the headquarters level groups that were identified through a preliminary sample of DoD documents.

Table 1. DoD Climate Change Task Forces

OSD	<p>Senior Sustainability Council (SSC), led by the DUSD for Installations and Environment (the Department's Senior Sustainability Officer) and the ASD for Operational Energy Plans and Programs is responsible for integrating the Sustainability Performance Plan into Department activities. Senior Sustainability Officers are required by Executive Order 13514, and are responsible for implementation of the EO preparation of targets for agency-wide GHG, the submission of a Strategic Sustainability Performance Plan, and the monitoring of agency performance and progress in meeting the goals of the order.</p> <ol style="list-style-type: none"> 1. Integrate sustainability into policies, plans, budgets, and decisions; 2. make recommendations on processes and procedures to implement the requirements of EO 13514 and other federal sustainability requirements; 3. continuously improve the Department's approach to the SSPP; and 4. review the adequacy of policies, resources, and performance in meeting goals, and make recommendations on changes required
Army	<p>"Senior Energy and Sustainability Council's (SESC's) Council of Colonels (the Army Climate Change workgroup has been merged into the SESC)</p>

Navy

Task Force Climate Change established in 2009. Flag level members from over 30 Navy offices, NOAA, and the Coast Guard make recommendations to Navy leadership regarding policy, investment, and action, in addition to public discussion.

Navy Climate Change Coordination Office, led by the Oceanographer of the Navy, supports the TFCC and executes TFCC guidance by developing plans and frameworks.

Climate Change Research, Analyses, and Methods Development

Strategic Environmental Research and Development Program, “SERDP Climate Change Program Review and NOAA Partnership Meeting Summary Report,” 2015; “Infrastructure Damage/Fragility Models and Data Quality Issues Associated with Department of Defense Climate Vulnerability and Impact Assessment,” 2015; “Assessing Impacts of Climate Change on Coastal Military Installations: Policy Implications,” 2013 accessed at: <https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Climate-Change/Climate-Change>

Funded through the DoD, SERDP is DoD's environmental science and technology program done in partnership with DoE and EPA. SERDP supports research in environmental restoration; munitions response; resource conservation, and climate change; and, weapons systems and platforms. Climate change research focuses on: the development of region specific tools and models to better understand the potential effects on the built and natural infrastructures of installations, ranges, and surrounding communities; studying how to enhance the resistance, resilience, or recovery capacity of built and natural infrastructures; improving the understanding of carbon cycle dynamics across various vegetation types and landforms; and research on adaption of the hydrologic cycle under changing climate conditions.

For example, SERDP funded the US Army Engineer Research and Development Center (ERDC) to develop a method to quantify the risks of sea level rise in combination with coastal storms effects on critical infrastructure using Naval Station Norfolk, Virginia as a test case. The risk-based approach that was developed can be used to assess risks to missions on other military installations as well as vulnerability and risks at the regional scale to encourage preparedness and enhance coastal resiliency both on and off military installations.⁴ Table 2 presents sample of climate change related research funded by the SERDP program.

⁴ Kelly A. Burks-Copes, et al., “Risk Quantification for Sustaining Coastal Military Installation Asset and Mission Capabilities (RC-1701),” June 6, 2014 accessed at: <https://www.serdp-estcp.org/Program-Areas/Resource-Conservation-and-Climate-Change/Climate-Change>

Table 2. Select SERDP Research on Climate Change Adaptation

Title
Integrated Climate Change and Threatened Bird Population Modeling to Mitigate Operations Risks
Effects of Near-Term Sea-Level Rise on Coastal Infrastructure
A Methodology for Assessing the Impact of Sea Level Rise on Representative Military Installations in the Southwestern United States
Risk Quantification for Sustaining Coastal Military Installation Assets and Mission Capabilities
Shoreline Evolution and Coastal Resiliency at Three Military Installations: Investigating the Potential for and Impacts of Loss of Protecting Barriers
Addressing the Impacts of Climate Change on U.S. Army Alaska with Decision Support Tools Developed Through Field Work and Modeling
Decision Scaling: A Decision Framework for DOD Climate Risk Assessment and Adaptation Planning
Assessing Climate Change Impacts for DOD Installations in the Southwest United States during the Warm Season
Understanding Data Needs for Vulnerability Assessment and Decision Making to Manage Vulnerability of DOD Installations to Climate Change
Climate Change Impacts and Adaptation on Southwestern DOD Facilities
Climate Change Impacts to Department of Defense Installations
Defense Coastal / Estuarine Research Program
The Impact of Sea-Level Rise and Climate Change on Department of Defense Installations on Atolls in the Pacific Ocean
Advancing Best Practices for the Formulation of Localized Sea Level Rise/Coastal Inundation “Extremes” Scenarios for Military Installations in the Pacific Islands
Impacts of Changing Climate on Pacific Island-Based Defense Installations
Water Resources on Guam: Potential Impacts and Adaptive Response to Climate Change for Department of Defense Installations
Improving Design Methodologies and Assessment Tools for Building on Permafrost in a Warming Climate

SOURCE: Congressional Research Service (CRS), SERDP, <http://www.serdp.org/Program-Areas/Resource-Conservation-and-Climate-Change/Climate-Change>

NOTE Data as of May 2014.

USACE, “Department of Army High-level Climate Change Vulnerability Assessment,” October 2013 accessed at: <http://www.asaie.army.mil/Public/ES/doc/ArmyHigh-LevelClimateChangeVulnerabilityAssessment2013final.pdf>

High-level vulnerability assessment of Army installations performed as directed in the 2010 QDR, which required the DoD to “complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required.” Using the National Climate Assessment projections for each region, an analysis of likely effects on installations was performed. For example, those installations in the Northeast region, more so

than others, are in urban areas and may be more interdependent on the capabilities of associated civil authorities for built infrastructure, communication, human safety, and transportation networks if a large weather event occurs. Therefore mitigation for vulnerabilities need to be assessed in a regional context to a greater extent than for other regions. Higher temperatures will result in higher energy requirements for cooling. Regional shifts in species distributions and stress on natural systems may challenge some installations like Fort Dix, which may become more important as a regional reservoir of biodiversity, or installations like Fort Drum, which have federally listed species and species of concern, where stress on the natural systems may result in increases in regulatory compliance requirements and constraints on training missions.

Anticipated climate change effects on natural systems in the Northeast Region include shifts in species distributions, changes in community structure, and additional stressors on sensitive systems. The relatively urbanized and small land areas of Army installations in this region suggests these effects on natural systems will have limited direct effects on most installations, particularly with regard to regulatory constraints.

Jenicek, Elisabeth M. et al., “Water Sustainability Assessment for Ten Army Installations,” USACE, March 2011 accessed at: http://www.aepi.army.mil/docs/whatsnew/ERDC-CERL_TR-11-5%20Water%20Sustainability%20Assessment%20for%20Ten%20Army%20Installations.pdf

This report analyzed water demand and availability at a watershed level over a 30-year time frame for ten Army bases within the United States to inform policies to support sustainable water management. Five scenarios were applied to each installation, and the scenarios included projections of climate change effects.

Jenicek, Elisabeth M. and Natalie R.D. Myers, “Army Installations Water Sustainability Assessment, an Evaluation of Vulnerability to Water Supply,” USACE, Sept. 2009, accessed at: http://www.aepi.army.mil/docs/whatsnew/ERDC-CERL_TR-09-38.pdf

The report presented regional water supply and demand assessments in regions containing Army installations to determine the potential for water scarcity within 30 years. Methodologies developed by the U.S. Army Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC/CERL) were used, three scenarios, including a climate change scenario, were applied to Forts Bliss, TX and Bragg, NC as case studies. Recommendations for achieving Federal water conservation targets contained in Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management, were also made.

Lozar, Robert C ; Hiett, Matthew ; Westervelt, James D, “Climate Change Impacts on Fort Bragg, NC,” Engineering Research and Development Center, 15 October 2013 accessed at: <http://www.dtic.mil/docs/citations/ADA589143>

This study exemplifies the types of analyses that the Department is performing to plan responses to potential climate change effects. Climate change scenarios developed by the Intergovernmental Panel on Climate Change (IPCC), along with established climate models and historical climate data specific to the geographic region surrounding Fort Bragg, were used to predict possible future climates in the region. These predictions, which include a longer rainy season with heavier rains, were used to assess the effects on personnel (e.g., need for more water, more fungus issues), training (fewer available days for airborne training and vehicular movement, higher temperatures, less fugitive dust, more mud making vehicular movement more challenging, etc.), and the natural landscape (more erosion, mixed responses from plant and animal species creating an increased need for T&ES management, etc.). Even though Fort Bragg is located in a region that is projected to have modest effects from climate change, this modelling effort presents data that suggests some adaptation will be necessary.

Audits and Implementation Assessments

Leggett, Jane A. “Climate Change Adaptation by Federal Agencies: An Analysis of Plans and Issues for Congress,” Congressional Research Service, February 23, 2015 accessed at: <https://www.fas.org/sgp/crs/misc/R43915.pdf>

Presents the plans and activities of Federal agencies including the DoD. Reviews DoD’s activities, largely summarizing information from the roadmaps and testimony. It includes a service specific narrative of activities. Some interesting highlights follow:

Congress may also consider whether and to what extent DOD should examine the potential risks climate change poses to the industrial base supporting DOD. As discussed above, climate-related effects are already being observed at numerous DOD installations. DOD and the services are working to develop predictive models, evaluate the impact of climate change, and incorporate climate change into installation management. It is unclear whether DOD plans to take a similar systematic approach to determine what impact, if any, climate change may have on critical industrial base facilities, such as shipyards, or whether DOD plans to evaluate the extent to which contractors are adequately preparing for potential environmental change.

Government Accountability Office (GAO), “Opportunities to Reduce Federal Fiscal Exposures Through Greater Resilience to Climate Change and Extreme Weather,” GAO-14-504T, July 2014 accessed at: <http://www.gao.gov/products/GAO-14-504T>

This report, prepared for the Committee on the Budget, U.S. Senate identifies DoD facilities as being highly vulnerable to effects of climate change and related extreme weather events. The report also notes that recent drought contributed to wildfires at an Army installation in Alaska, which limited training schedules and weapons usage. No further recommendations are included in this report beyond those identified in previous reports (e.g. Government Accountability Office (GAO) -14-446).

Government Accountability Office, “DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts,” GAO-14-446, June 2014 accessed at:
<http://www.gao.gov/products/GAO-14-446>

This report, prepared for the Committee on the Budget, U.S. Senate, recommends that DOD develop a plan and milestones for completing climate change vulnerability assessments of installations [*status: successfully implemented*]; provide further information to installation planners [*status: open*], clarifying actions that should be taken to account for climate change in planning documents [*status: open*]; and clarify the processes used to compare military construction projects for funding, to include consideration of potential climate change impacts [*status: open*].

Government Accountability Office, “Federal Efforts Under Way to Assess Water Infrastructure Vulnerabilities and Address Adaptation Challenges,” GAO-14-23, Nov. 2013 accessed at:
<http://www.gao.gov/products/GAO-14-23>

Government Accountability Office was asked to review agency actions to deal with climate change effects on water infrastructure, notably actions taken by the USACE since 2009. This report finds that USACE, in partnerships with other agencies, are addressing the challenges posed by climate change impacts to water infrastructure. These include identifying and obtaining data and tools needed by water managers to cope with climate change and guide federal research efforts, integrating climate science into water resource management decisions, and helping to develop a climate change science program for federal and nonfederal water resource managers.

Government Accountability Office, “Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers,” GAO-13-242, April 2013 accessed at:
<http://www.gao.gov/assets/660/653741.pdf>

While the focus of this analysis was NASA facilities, this report finds that DOD facilities in close proximity to NASA’s Langley Research Center, such as the Langley Air Force Base and the nearby Naval Station Norfolk, are also particularly vulnerable to flooding as a result of increased sea levels. The report notes that DOD’s Strategic Environmental Research and Development Program is conducting a multi-hazard risk quantification study on coastal military

installation assets and mission and is developing an inventory of assets and mission capabilities for Hampton Roads military installations. The GAO recommends that the Executive Office of the President (EOP) work with all federal agencies to identify the best climate related information to assist local infrastructure decision makers in their planning activities..

Government Accountability Office, “Improvements Needed to Clarify National Priorities and Better Align Them with Federal Funding Decisions,” GAO-11-317, May 2011 accessed at: <http://www.gao.gov/assets/320/318556.pdf>

This report to the Ranking Member, Committee on Natural Resources, House of Representatives finds that climate change funding by the DoD, as reported by OMB, has increased from 83 to 226 million dollars between 2003-2010. The 2010 funding is divided as follows: RDT&E Army – \$93 million, RDT&E Navy – \$13 million, RTD&E Air Force – \$120 million. GAO’s recommendations are that the appropriate entities within the EOP, in consultation with Congress, clearly establish federal strategic climate change priorities and assess the effectiveness of current practices for defining and reporting related funding.

Government Accountability Office, “A Coordinated Strategy Could Focus Federal Geoengineering Research and Inform Governance Efforts,” GAO-10-903, Sept. 2010, <http://www.gao.gov/assets/320/310105.pdf>

This report to the Chairman, Committee on Science and Technology, House of Representatives, notes that the DoD funded a \$250,000 DARPA project to study methods of removing methane and nitrous oxide greenhouse gases from the atmosphere using enzymes, which falls under the geoengineering approach to mitigating climate change. GAO recommends that within the Executive Office of the President, the appropriate entities, such as the Office of Science and Technology Policy (OSTP), establish a clear strategy for geoengineering research in the context of the federal response to climate change to ensure a coordinated federal approach

Government Accountability Office, “Strategic Federal Planning Could Help Government Officials Make More Informed Decisions,” GAO-10-113, October 2009, <http://www.gao.gov/assets/300/296526.pdf>

In a report to the Chairman, Select Committee on Energy Independence and Global Warming, House of Representatives the GAO notes that the DoD’s Legacy Resource Management Program is working with other agencies to develop a guidance manual that will summarize available natural resource vulnerability assessment tools. Additionally, the DoD Quadrennial Defense Review examines the capabilities of the armed forces to respond to the consequences of climate change. In October 2008, the Air Force participated in a Colloquium on National Security Implications of Climate Change sponsored by Joint Forces Command, and the

Navy recently sponsored a study on the National Security Implications of Climate Change on U.S. Naval Forces (Navy, Marine Corps, and Coast Guard). GAO recommends that within the Executive Office of the President the appropriate entities, such as the Council on Environmental Quality (CEQ), develop a national adaptation plan that includes setting priorities for federal, state, and local agencies.

Appendix A

Table A.1. DoDD 4715.21. January 14, 2016

	INTELLIGENCE	STRATEGY and Planning	POLICY	RDT&E	ACQUISITION	LOGISTICS	INFRASTRUCTURE	TRAINING	Mission OPERATIONS	Relevant EO, DoDD, DoDI
USD (Acquisition Technology & Logistics)			Develops and oversees implementation of climate change adaption/resilience policy May establish working groups Establishes reporting metrics Ensures modeling consistent with DoDD 5000.59							DoDD 5000.59
ASD (Energy Installations & Environment)		Primary climate change adaptation official Oversees identification and management of climate change-related risks Leverage SERDP to develop assessment and adaptation planning tools	Collaborates with USD(P) and CJCS for climate change adaptation and resiliency in all military planning processes. Collaborate with DoD issuance Principal Staff Assistants to integrate climate change into existing policies, procedures, and programs	Primary responsibility for adaption, including overseeing research, development, testing and evaluation programs in collaboration with the Services, other federal agencies and the private sector. Coordinate with ASD (Research and Engineering) Collaborates with components and other federal agencies to support the private sector and professional organizations to identify, develop, demonstrate technologies, engineering standards, tools, and approaches that enable adaptation. Provide guidance and direction on technologies, engineering standards, tools, scenarios, and approaches to enable adaptation	Advises DAB and other acquisition bodies on climate change considerations for programs		Incorporate adaption in installation planning and basing processes including natural and built infrastructures. Engage State and local governments to promote compatible development through the Joint Land Use Study Program.			EO 13653 DoDI 4120.24 DoDI 3030.3 DoDI & DoDM 4715.03?
ASD for Logistics and Materiel Readiness						Responsible for identifying risks and appropriate actions to manage these risks to: logistics infrastructure, materiel acquisition and supply (including critical suppliers/components), key transportation modes and routes, and stockpile activities. Integrates climate change into policies under L&MR The global impacts of increasing storm surge, rising sea-levels, flooding risk and extreme operating conditions fall within this purview.				

	INTELLIGENCE	STRATEGY and Planning	POLICY	RDT&E	ACQUISITION	LOGISTICS	INFRASTRUCTURE	TRAINING	Mission OPERATIONS	Relevant EO, DoDD, DoDI
ASD (Acquisition)					Responsible for incorporating climate risks into weapon systems, platforms, and equipment programs during acquisition or modification Develops and updates policies to integrate climate change into mission area analyses, acquisition strategies, across the life cycle of weapons systems, platforms, and equipment.			Oversees integration of climate-change policy and practices in acquisition workforce training and education.		DoDD 5000.01 DoDI 5000.02 CJCS 3170.01
ASD (Research and Engineering)				In coordination with ASD (EI&E): -Overseas defense-related research in climate science -Develops guidance and direction on relevant technologies. -Overseas DoD engagement with the US Global Change Research Program through the NSTC						EO 12881
ASD (Homeland Defense and Global Security)									Coordinates homeland defense activities in response to the effects of climate change under the control of USD(P). Includes national preparedness, crisis management, defense mobilization in emergencies, defense continuity programs, mission assurance, the Defense Support of Civil Authorities, and continuity of operations and government.	DoDI S-2005.01
USD (Policy)			Develops, in coordination with USD (AT&L), policies, plans, programs, forces and posture needed to implement the National Security Strategy including adaptation actions,							
USD (Personnel and Readiness)							Integrates climate change considerations into training range sustainment policy objectives established in DoDD 3200.15 Identifies trends that may impact training ranges and capabilities across DoD, and oversees component implementation of strategies to sustain training range capabilities	Assesses effects of climate change trends on training capabilities Considers the impacts of climate change trends on the safety, health, and well-being of military and civilian workforce		DoDD 3200.15
USD (Intelligence)	Manages climate-related investments and risks for all DoD Intelligence activities and works with the Director of National Intelligence to assess and manage the risks, impacts, vulnerabilities and effects of climate									

	INTELLIGENCE	STRATEGY and Planning	POLICY	RDT&E	ACQUISITION	LOGISTICS	INFRASTRUCTURE	TRAINING	Mission OPERATIONS	Relevant EO, DoDD, DoDI
Chairman of JCS									Integrates climate change considerations into joint exercises and war games with allies and partners	
Component Heads	Leverage authoritative environmental sources for data and analysis products to assess weather and climate change effects.	Assess, incorporate, and manage the risks and effects on capabilities including force structure, basing, operations, capacity building, stability operations, and demand for HA/DR and DSCA in short- and long-term planning. Collaborate with internal and external stakeholders to address common challenges and opportunities.	Integrate climate change into Component policy, guidance, plans, and operations.		Assess and manage vulnerabilities to the life cycle of weapon systems, platforms, equipment and products within the Service. Integrate resource considerations and cost management into plans, processes, material management, and acquisition strategies.	Integrate resource considerations and cost management into plans, processes, material management, and acquisition strategies. Incorporate climate change effects into investment and risk management processes.	Assess and manage risks to built and natural infrastructure to include installation master planning, natural and cultural resource management, standards, asset management, encroachment management, utility systems, and emergency operations. Collaborate with internal and external stakeholders to address common challenges and opportunities. Integrate resource considerations and cost management into planning, investment, and risk management processes.	Assess and mitigate effects on training and test activities, including supporting training range complexes. Incorporate key climate change concepts affecting mission, DoD Adaptation, and resiliency into education and training programs.	Integrate climate change considerations into mission manning, training, and equipping. Collaborate with internal and external stakeholders to address common challenges and opportunities.	
Combatant Commanders		Assess the risks to security interests and operations including campaign planning and operations and contingency planning. Review requirements for HA/DR and DSCA.						Require country-specific cooperation and engagement including training and exercises for addressing climate change effects.	Incorporates climate change effects into plans and operations, assessing the risks to national security within their domain and requiring country-specific cooperation.	
Director, Test Resource Management Center		Collaborates with internal and external stakeholders to address common climate change challenges and opportunities, including regional planning efforts						Oversees integration of climate change considerations into DoD testing range sustainment policies		DoDD 3200.15 DoDD 5105.71
ASD (Special Operations and Low-Intensity Conflict)		Monitors and directs appropriate plans for HA/DR that address climate change impacts Incorporates climate risks into stability operations policy, doctrine, and planning								